CHEMICAL BIOLOGICAL DEFENSE TECHNOLOGY BASE PROGRAM

Dr. David E Tevault
Basic Research Business Area Manager

DoD Non-Med Tech Base Process

◆ **Addresses all phases of research in five commodity areas (modeling/simulation, detection, individual protection, collective protection, decontamination)**

◆ **Executed by Principal Investigators within Service labs**

◆ **Utilizes proposal-driven process focused by user-developed desired operational capabilities**

◆ **Responsive to development/acquisition program**

◆ **Managed as Joint Services program**

Management Structure

Oversight and guidance

Joint S&T Panel

Mr. Merlin Erickson
Chair, Army

Dr. Raymond Mackay **Army Rep**	**Mr. Joseph Brumfield** **Navy Rep**	**LTC Stephen Channel** **Air Force Rep**	**Mr. Salvatore Clementi** **Marines Rep**

COL Edwin Armitage
Med Rep

Mr. Dennis Kravec
Business Manager

Dr. Randolph Long
Tech Coordinator

Program devt/execution

Business Area Mgrs

Dr. Ronald Ferek **Info Sys Tech** N	**Dr. Ngai Wong** **CB Point Detn** AF	**Mr. William Loerop** **CB Standoff Detn** A	**Dr. Edward Stuebing** **Supt Sci/Tech** A
Mr. Anthony Ramey **Ind Protection** N	**Mr. Bruce Nielsen** **Col Protection** AF	**Dr. John Weimaster** **Decontamination** A	**Dr. David Tevault** **Basic Research** A

Joint Future Operational Capabilities Ranking: Driver for Investment

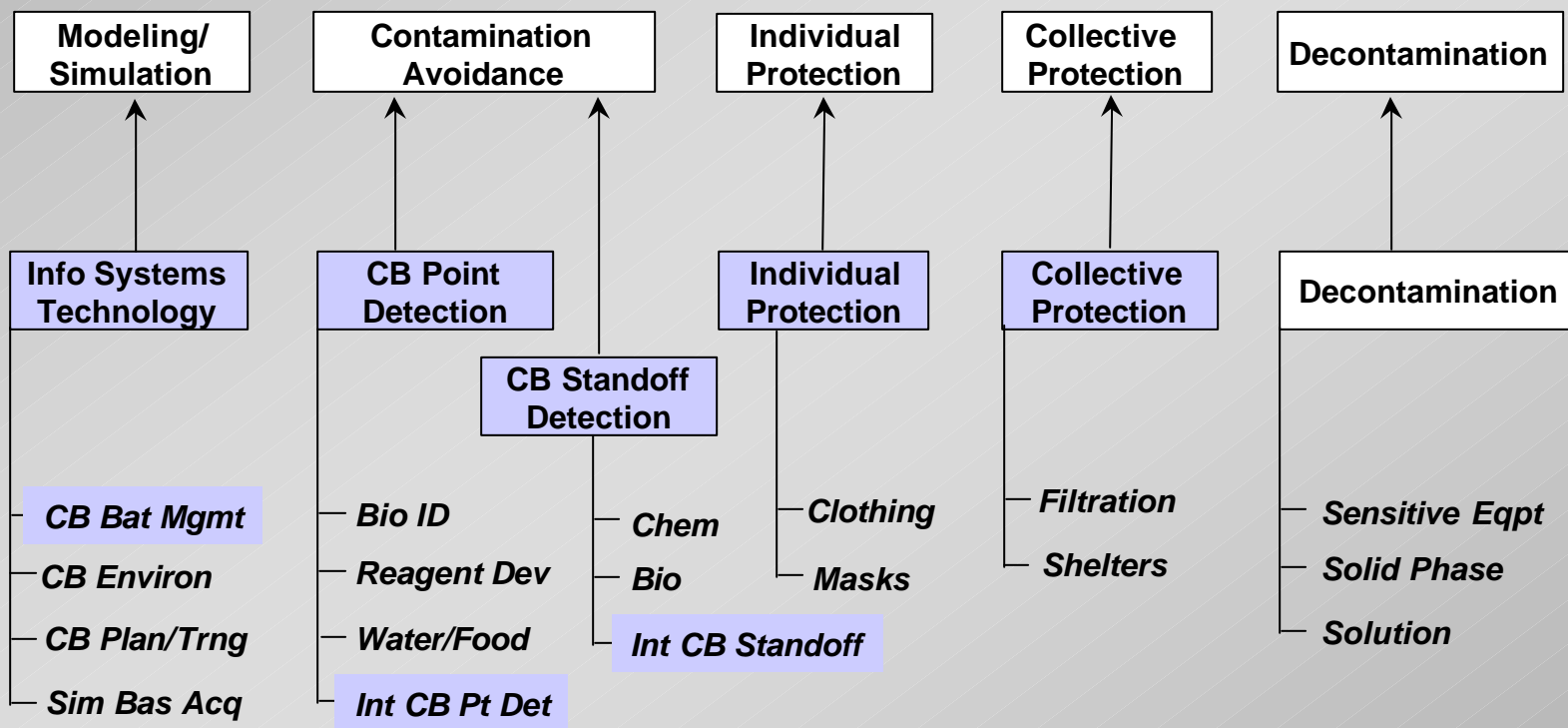|	
1 BatMgt - Battle Management Systems	11 ConAvoid – Sensor Integration
2 ConAvoid - Biological Early Warning	12 Restore – Medical Diagnosis
3 BatMgt - Battle Analysis	13 ColProt – Mobile Applications
4 ConAvoid – Chemical Early Warning	14 Restore – Medical Treatment
5 BatMgt – Modeling & Simulations Training	15 ConAvoid – Radiological Early Warning
6 IndProt – Medical Prophylaxes	16 Restore – Equipment/Facilities/Large
7 ConAvoid – Biological Point Detection	17 Restore - Logistics
8 IndProt – Respiration & Percutaneous	18 ColProt – Fixed Site Applications
9 ConAvoid – Med Surveillance/ Vet Support	19 ConAvoid – Radiological Point Detection
10 ConAvoid – Chemical Point Detection	20 Restore – Personnel/Patient Decon

Non-Med CB Defense Program Taxonomy

Commodity Areas

| Modeling/ Simulation | Contamination Avoidance | Individual Protection | Collective Protection | Decontamination |

S&T Business Areas

| Info Systems Technology | CB Point Detection | | Individual Protection | Collective Protection | Decontamination |

CB Standoff Detection

Thrust Areas

- *CB Bat Mgmt*
- *CB Environ*
- *CB Plan/Trng*
- *Sim Bas Acq*

- *Bio ID*
- *Reagent Dev*
- *Water/Food*
- *Int CB Pt Det*

- *Chem*
- *Bio*
- *Int CB Standoff*

- *Clothing*
- *Masks*

- *Filtration*
- *Shelters*

- *Sensitive Eqpt*
- *Solid Phase*
- *Solution*

Foundation S&T Business Areas

Supporting S&T
- *CB Threat Agents*
- *Low-Level Op Tox*
- *Aerosol Technology*

Basic Research
- *all thrust areas*
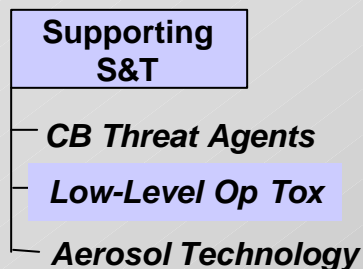
Areas involved in change process for FY01

Three years

Twelve years

Joint Bio Point Detn System

- Fully Automated
- 12 Hour Continuous Operations
- 10 Agent ID within Minutes of Detection
- Sample Isolation
- < 30 Minute Set-up
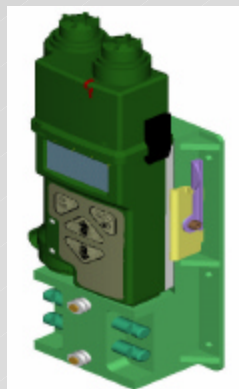
Joint Chem Agent Detector

- Hand size
- Miosis level detn of blister, nerve, blood
- Records dose
- Networked, remotely controlled

Joint Modular CB Detector

- Hand size (40 cu in)
- Identifies chemical agents
- Detects bio agents
- Networked

Information Systems Technology
Thrust Areas

❖ **New thrust area for FY01-02**

❖ **Sub-thrusts include**

➢ **Sensor integration**

➢ **Information management**

➢ **Data fusion**

➢ **Communications interfaces**

➢ **Visualization approaches**

▪ **Panel of experts meeting is planned to refine/develop program objectives**

➢ **Disparate sensors – non-CB sensors that can provide info on CB events**

FY01 activities:
6.2: Survey, characterize available potential sensors, e.g., acoustic, seismic sensors, FLIRs

6.3: Conduct field evaluation of radar as standoff CB event cueing device as well as sensors identified in 6.2; joint with PM-NBC
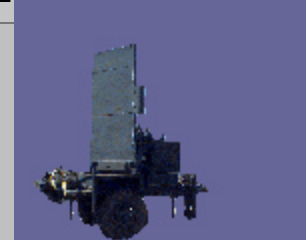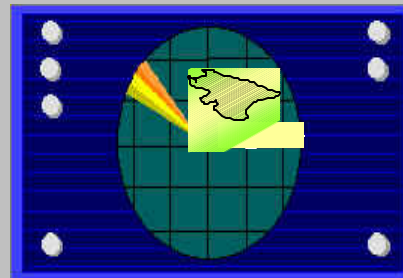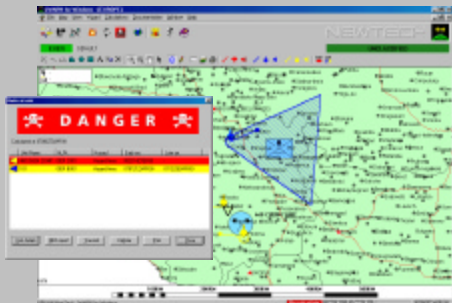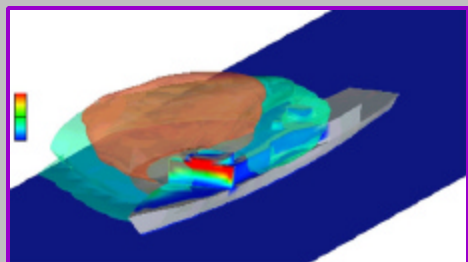

Q36/Q37

Information Systems Technology
Thrust Areas

CBW Environment

Objective: Models to track evolution of CB threats from vapor, liquid, and solid agents across range of scales from individual to theater
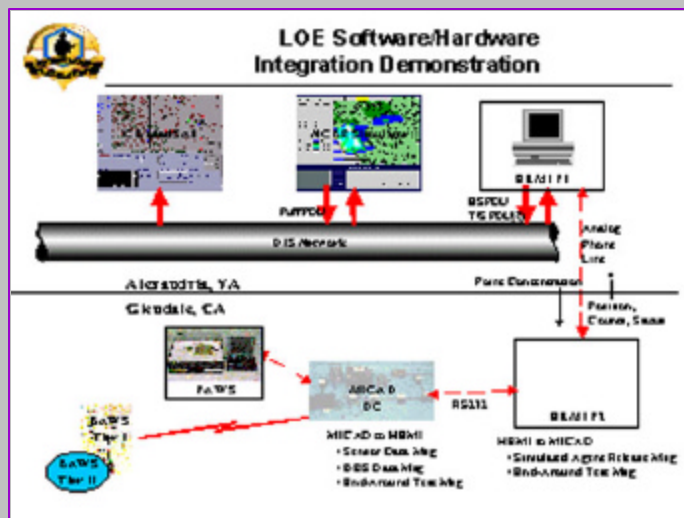

CBW-CFX Model

CB Planning/Analysis

Objectives: Models to describe effects of CBW on operations

Simulation Based Acquisition

Objective: Models supporting development of CBD equipment

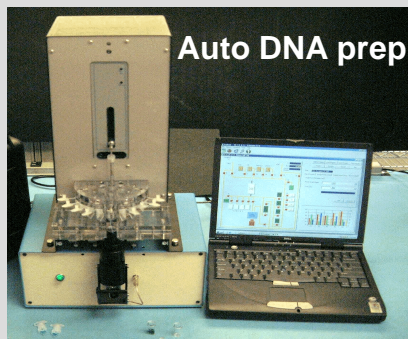LOE Software/Hardware Integration Demonstration

CB Point Detection
Thrust Areas

Biological Identification

Objectives: Develop fully automated sample prep and analysis systems for unattended monitoring of air samples; transition FY02 to JBPDS

Challenges:
- **fluidics**
- **biomarker extraction/cleanup**
- **background interference**
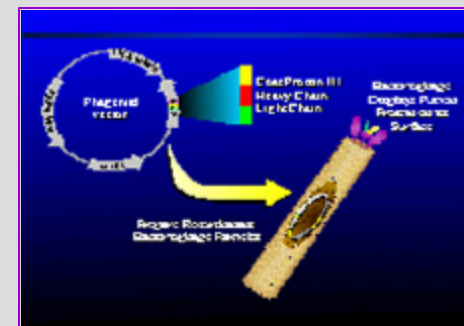

Auto DNA prep

Auto MS prep

❖ *Demonstrated detection of mass and genetic markers at JPBDS requirement levels; built 2 cu ft breadboards*

Reagent Development

Objectives: Develop improved reagent candidates for implementation in fielded and developmental identifiers via Critical Reagent Program

Challenges:
- **specificity**
- **shelf life**
- **reproducibility**

❖ *Demonstrated improved sensitivity of recombinant antibodies vs available monoclonals; initiated assessment of combinatorial peptide*
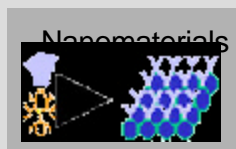
CB Point Detection
Thrust Areas

Detection in Water/Food

Objectives: Provide the capability to detect, identify, and quantify chemical and biological contamination in potable water

Challenges:
- **Non-traditional threat environment**
- **Immature technologies**
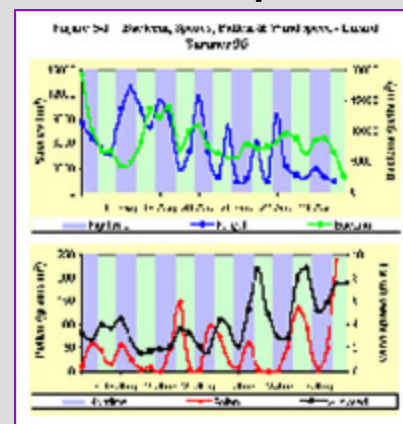- **Sampling low level toxics**

Nanomaterials

❖ *Model technology downselect process utilized fair assessment of technology candidates from all sources*

Supporting Science

Objectives: Assemble database of available ambient background data and analyze for key heuristics

Challenges:
- **multiple sources of data**
- **disparities in collection parameters**

❖ *Established joint DoD/DOE/TTCP website; data loading and analysis in process*

Integrated Chem Bio Point Detectors

Objectives: Develop small, hand-size detectors to identify chemical agents and detect/discriminate biological agents

Challenges:
- ➢ Miniaturization of detector technologies
- ➢ Small, efficient air samplers
- ➢ Simultaneous optimization of size, selectivity, and sensitivity

Pyrolysis-GC/IMS

Optical fluorescence

❖ *Py-GC/IMS demonstrated high detection probability and sensitivity relative to other candidates at JFT-6*

❖ *Air samplers evolving to smaller size with increased efficiency*

CB Standoff Detection
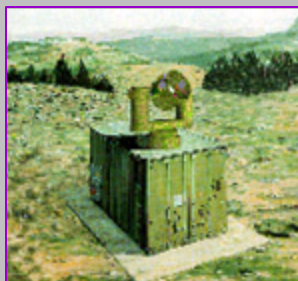## Thrust Areas

Chemical Standoff Detection

Objectives: Develop and demonstrate passive and active concepts for remote detection, identification, ranging, and mapping of chemical clouds in all physical forms

Challenges:
- High speed interferometry; focal plane arrays
- Rapid data processing, software
- Laser technology to reduce size, weight of active systems

Chemical Imaging Sensor

JS Warning ID Lidar

❖ *Demonstrated 100 scan/sec operation in field with 9-pixel array passive CIS spectrometer*

Bio Standoff Detection

Objectives: Develop and demonstrate concepts for remote detection, identification, ranging, and mapping of biological particulate clouds

Challenges:
- Laser technology to reduce size, weight of active systems
- Rapid data processing, software
- Spectroscopic technologies to enhance potential for classification

Short-range BSDS

❖ *Initiated panel of experts to develop and down-select concepts for exploration under Bio Standoff DTO*

Integrated
CB Standoff Detection

Objectives: Develop and demonstrate concepts for remote detection, identification, ranging, and mapping of chemical and biological clouds in all physical forms with a single sensor platform

Challenges:
- **Laser technology to reduce size, weight of active systems**
- **Significant advances in spectroscopy**
- **Rapid data processing, software**

Short-range BSDS

JS Warning ID Lidar
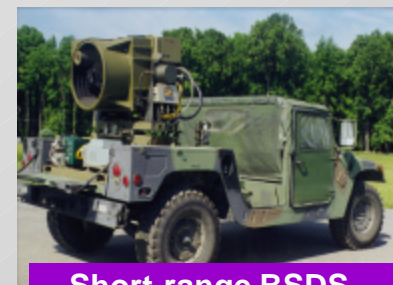
Merge capabilities into a single small platform

?

Individual Protection
Thrust Areas

Clothing

Objectives: Develop overgarments against CB agents that provide increased protection with decreased impediment of wearer's performance

Challenges:

➢ Selectively permeable materials
➢ Interface of SPMs with garment fabric
➢ Testing
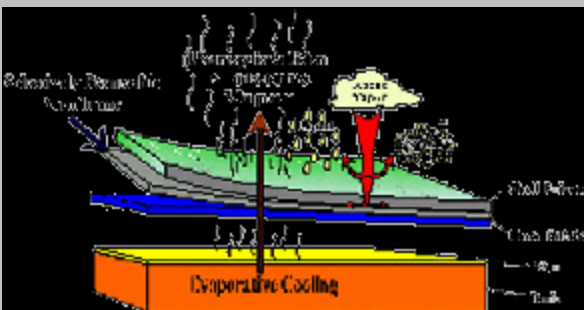
❖ *Developed and demonstrated two SPM garments that outperform all fielded garments and are 50% lighter*

Masks

Objectives: Demonstrate concepts that enhance respiratory and head protection against CB agents

Challenges:

➢ Adsorbent materials
➢ End-of-service life indication
➢ TICs/TIMs

❖ *Met or exceeded all JSGPM filter goals*

Collective Protection
Thrust Areas

Filtration

Objectives: Develop filtration approaches that reduce frequency of filter changes and are applicable to all toxic materials

Challenges:
- residual life indicators
- filter regeneration
- biological filtration

❖ *Completed evaluation of filter adsorbents against TICs*

Shelters

Objectives: Develop collective protection shelters with improved environmental isolation against threats from CB and toxic materials

Challenges:
- Hermetic seals
- Rapid deployment

❖ *Transiitoned low cost tentage effort to JTCOPS*

Decontamination
Thrust Areas

Sensitive Equipment

Objectives: Decontaminate sensitive equipment, interiors of combat vehicles and aircraft, and interiors on the move.

Challenges:
- Identify freon alternatives
- Material compatibility
- Man-portable, on-the-move decon
- Agent destruction following removal

❖ *Conducted technology assessment and identified leading candidates for JSSED program. Identified hydrofluoroether as freon alternative.*

Solid Phase

Objectives: Investigate and validate cost effective deactivation and destruction of CW agents rapidly by solid matrices. Extend technology to areas beyond sorbent decon.

Challenges:
- Mass transfer constraints
- Enhance chemical reactivity

❖ *Measured kinetics of VX, GD, and HD on nanosize calcium oxide and aluminum oxide. Autocatalytic for HD elimination process.*

Decontamination
Thrust Areas

Solution Chemistry

Objectives: Develop decon systems that supplement or replace existing systems used for immediate, operational and thorough decon and to replace DS2 and aqueous bleach in thorough decon applications.

Challenges:
- Optimize chemistry - co-solvents
- Stabilize the system
- Peroxide logistic issue

❖ *Candidate formulations have been identified that react rapidly and effectively for HD, GD, and VX.*

Enzyme Reactants

Objectives: Develop and demonstrate a new generation of CB warfare agent decontaminants that are non-toxic, non-corrosive, non-flammable, environ. safe and lightweight.

Challenges:
- Identify appropriate enzymes
- Genetic engineering needed for large scale production
- Maintenance of catalytic activity

Sub-thrust to solution chemistry

❖ *Increased activity on enzymes with activity for V-agents by 10-fold over baseline. Identified materials technology approach to destroy H-agents.*

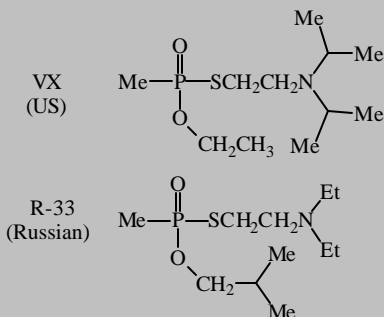# Supporting Science and Technology
Thrust Areas

Threat Agents

Objectives: Maintain awareness of evolving threat agent materials and conduct R&D studies to validate and characterize, and to assess fate of CB materials in environment

Challenges:

- ever expanding array of threats
- infrastructure issues
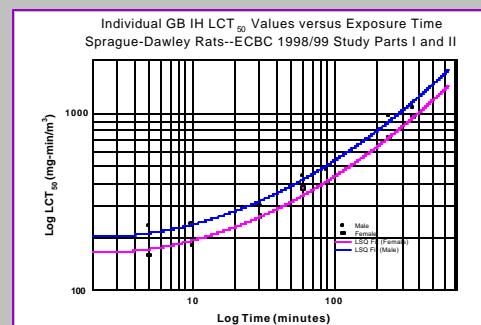- identification of adequate simulants

VX (US)

R-33 (Russian)

❖ *Conducted multiagency workshop on bioaerosol threat*

Low-Level Operational Toxicology

Objectives: Develop sound values for exposure levels having physiological impact below acute response levels to guide development of detectors and protective equipment

Challenges:
- Identifying physiological indicators of low level exposure
- Developing exposure methodologies
- Extrapolating to human response

Individual GB IH LCT_{50} Values versus Exposure Time
Sprague-Dawley Rats--ECBC 1998/99 Study Parts I and II

❖ *Extend CT range for acute effects*

Supporting Science and Technology
Thrust Areas

<u>Aerosol Technology</u>

Objectives: Characterize and test developmental air samplers/collectors; evolve new concepts toward next-generation small air samplers

Challenges:
- ➤ **high velocity test challenges**
- ➤ **size, power required to sample large volumes**
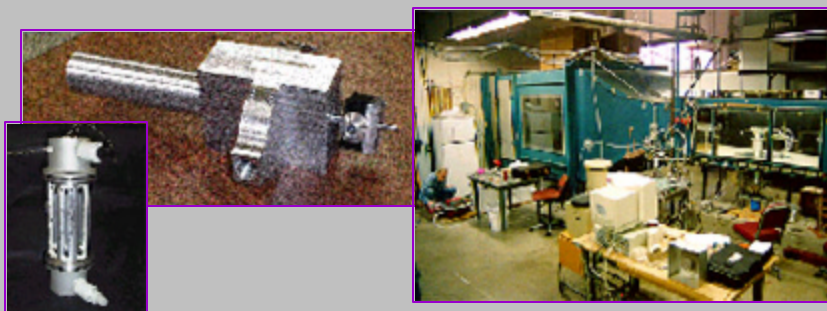
❖ *Developed isokinetic, isoaxial reference reference sampler; developed new microslit transpirated impactor*

Acknowledgement

Dr. S. Randolph Long